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Diagnostic Tools for Weed Science

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Persons involved in production agriculture have a wide array of new technology available to help make management decisions. This paper will discuss two diagnostic tests that may have practical use now or sometime in the future.

Triazine Resistant Test

Although herbicide resistant weeds are not a widespread problem in Iowa at this time, changes in herbicide use patterns and production practices have increased the potential for this problem. Currently, triazine resistance is the most widespread type of herbicide resistance found in Iowa. Drs. Don Penner and Jim Kells at Michigan State University recently developed a diagnostic kit to confirm resistance to the triazine herbicides in weeds. The AGRI-SCREEN Triazine Resistance Test is currently marketed by Neogen Corporation, and has been advertised in several agri-chemical trade magazines.

The Triazine Resistance Test can be used in the field to quickly determine whether a weed is resistant to the triazine herbicides. Resistance is most likely to occur in fields where triazine herbicides have been used repeatedly for more than ten years. The presence of a single species escaping control, in contrast to a total herbicide failure, is good indication that a resistant species may be present in a field. Confirming resistance in a field with the Triazine Resistance Test may provide information needed to adjust the weed management program in response to the presence of resistant species.

Atrazine and other triazine herbicides are potent inhibitors of photosynthesis. The test uses a simple technique to measure the production of O_2, a product of photosynthesis, in plants suspected to be triazine resistant. The first step of the test is to place leaf discs in a test tube containing a solution of atrazine and buffers. A vacuum is created in the tube using a syringe, therefore removing air from the leaf discs and causing them to sink. If the plant from which the leaf disc was taken is susceptible to triazine herbicides, photosynthesis will be inhibited and the disc will remain at the bottom of the test tube. However, if the disc was taken from a triazine resistant plant, photosynthesis will continue even though atrazine is present in the solution. The O_2 produced inside the leaf disc will cause the leaf disc to float to the surface of the atrazine solution. Resistance is determined by whether or not the leaf discs float.

Cost for the kit is approximately $15; each kit contains enough supplies to conduct three tests. Further information concerning the kit can be obtained from Neogen Corporation, 517-372-9200.

Immunoassay Pesticide Detection Kits

Analysis of water, soil and plant residues for pesticides has been based primarily on the use of gas chromatography (GC) and high-performance-liquid chromatography (HPLC). Although these methods are highly sensitive, they are also very expensive and time consuming. Immunoassay tests are an alternative analytical method that are also highly sensitive, but are less expensive and can be used by persons with little or no scientific background. A typical immunoassay kit costs approximately $150 for enough supplies to analyze 15 samples. This compares to a cost of $50 to $80 to have a single sample analyzed by a commercial testing lab.

The heart of immunoassay detection kits are antibodies developed specifically for the chemical recognized by the kit. An antibody is a protein produced by animals following introduction of a foreign substance (antigen). Antibodies are highly specific and will bind only to the antigen or closely related compounds. Binding of the antibody to the antigen allows the foreign substance to be removed from the animal before it causes any damage. By combining an antibody specific to a pesticide with an appropriate indicator system, an immunoassay test can be developed that has the ability to detect concentrations of 1 ppb or less (Figure 1).

Potential applications of immunoassay tests in agriculture include testing for pesticide or antibiotic residues, diagnosing animal or plant diseases, and determining mycotoxins in grain or feed. Detection kits have been developed for numerous pesticides, including atrazine, 2,4-D, alachlor, carbofuran, aldicarb, and benomyl. Currently, immunoassay pesticide detection kits are used primarily for analyzing water samples for pesticides and are targeted for research uses.

Although immunoassay tests offer certain advantages over traditional analytical tests, they do have several limitations. Most immunoassay tests are better suited for giving a yes or no answer on whether the pesticide is present, rather than determining the exact concentration in the sample. In addition, many of the kits currently on the market are not specific for a single compound. Thus, a positive response may be induced by a degradation product or related compound, rather than the chemical of interest.

From a crop production standpoint, one of the most desirable uses of immunoassay tests would be to analyze soil samples for herbicide residues that might injure rotational crops. Unfortunately, most herbicides bind tightly to soil colloids which greatly complicates analyses. In order to get an accurate estimate of the quantity of chemical in the soil, fairly rigorous extraction procedures must be used to remove the herbicide from the soil colloids. These extraction procedures require strong solvents that are not readily available and pose a disposal problem.

Summary

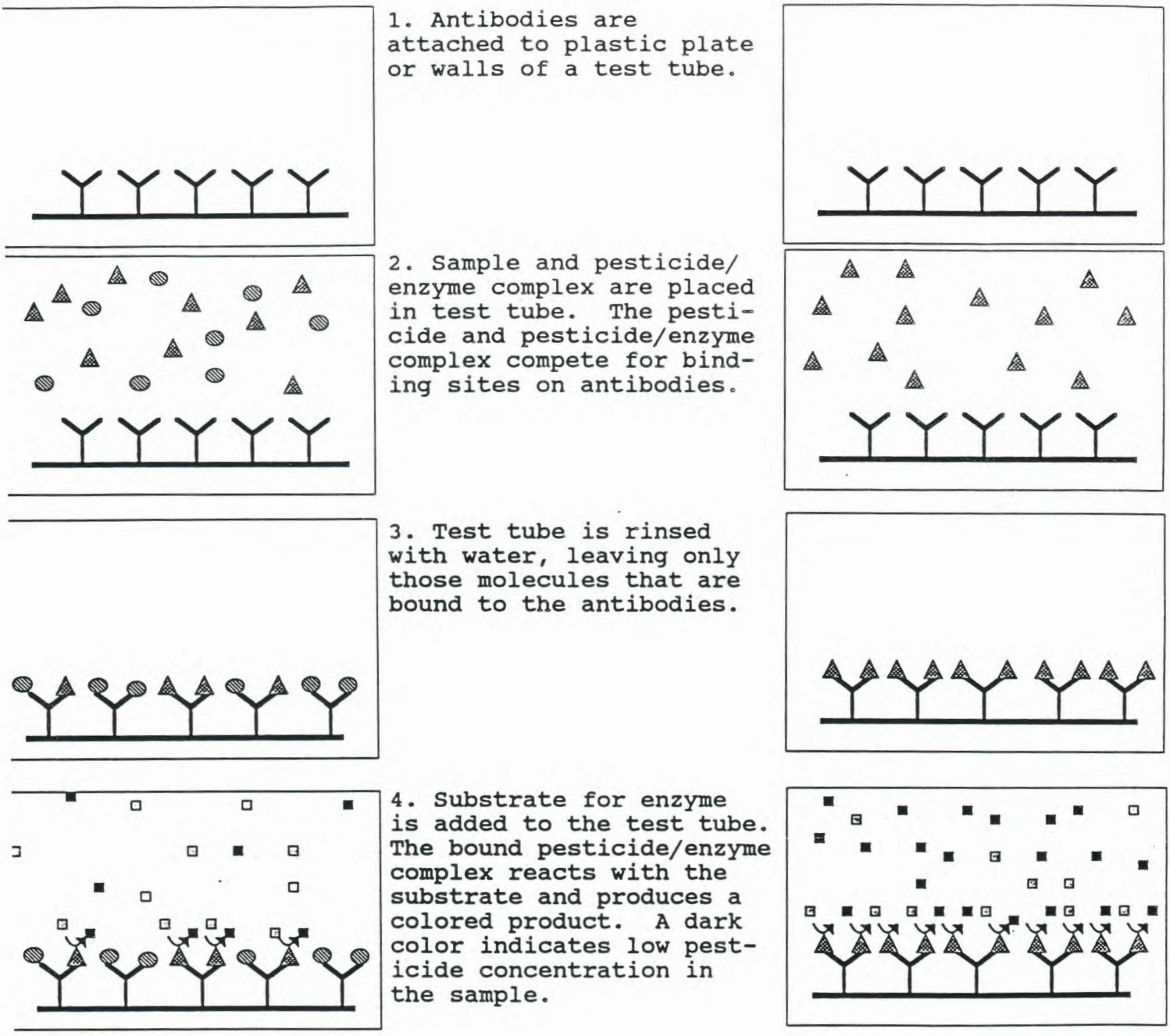
The Triazine Resistance Test kit is an inexpensive method for determining whether triazine resistance occurs in a field. Confirming resistance in a field may prevent a herbicide application destined for failure due to presence of a resistant weed biotype.

Immunoassay pesticide detection kits are still primarily a research tool that have not found a niche in production agriculture. However, other immunoassay tests are used for detecting the presence of plant pathogens and mycotoxins. This type of tool probably will grow in importance in the future.

FIGURE 1. **IMMUNOASSAY PESTICIDE DETECTION KITS**

Sample containing pesticide residue

Sample with no pesticide residue



LEGEND

- Antibody
- Pesticide
- Pesticide/enzyme complex
- Enzyme substrate
- Colored reaction product